Building the Aerospace Cluster in South Carolina

BY RICHARD KAGLIC

At the time of the Wright Brothers' first successful powered flight at Kitty Hawk, N.C., in 1903, few recognized just how big the industry would become or how transformative the location decisions of aircraft companies would be to regional economies. Today, aircraft manufacturing generates a tremendous amount of economic activity in clusters such as the Puget Sound area of Washington, Southern California, and St. Louis, Mo. — and, more recently, in South Carolina. State governments that recognize the tremendous economic value that aircraft manufacturing can bring their communities are actively courting such plants to bolster their aerospace clusters.

Boeing's 2009 decision to locate a 787 final assembly plant in North Charleston made South Carolina one of only two states with a large civilian aircraft final assembly plant. (Alabama will make it three when Airbus completes its A320 family assembly plant in Mobile later this year.) It is just the third site worldwide that is capable of assembling and delivering twin-aisle aircraft. Boeing's two decisions — first, to pursue the 787 project, and second, to locate a final assembly plant in South Carolina — resulted in a "big bang" for aerospace manufacturing in the state, creating an industry cluster out of virtually nothing.

Inevitably, when a cluster grows so rapidly in such a short period of time, there are bound to be growing pains. The area around North Charleston, where the 787 assembly plant is located, is already suffering from shortages of skilled labor. And a Chamber of Commerce-sponsored report on the outlook for skills gaps in the region paints a challenging picture. How quickly South Carolina is able to build up its human and capital infrastructure will go a long way toward determining how much bang the state will get from its incentive bucks. This article explores why aircraft manufacturing facilities are such attractive economic development targets, and how well positioned South Carolina is to maximize the return on its economic development investment in the aerospace manufacturing cluster.

Targeting Aerospace Clusters

Targeting industry clusters is a common regional development strategy, and for good cause. Economic theory suggests there are considerable benefits to having similar businesses agglomerating in a region. Most notable among the benefits are the synergies and efficiencies that clustered firms can derive from attracting labor with specialized skill sets to the region, as well as inputs common to the production process. Moreover, productivity within the cluster increases as knowledge "spills over" from one industry participant to another.

An aircraft final assembly plant falls into a more narrowly defined industry cluster known as a traded, or exporting, cluster. As opposed to a non-traded industry cluster, where the majority of the industry's output is consumed locally, traded industry clusters sell the majority of their output outside the region.

State and local economic development entities have limited funds, so they strategically focus those resources toward industries, or firms within industries, that will provide the highest return on investment and limited risk. Two of the most important criteria in decisions to deploy economic development dollars are the potential for strong growth over the long run and the creation of high-paying, high-value-added jobs.

Growth Potential

With regard to the first investment criterion, potential for growth, the outlook for manufacturing of large civilian aircraft is quite favorable. The demand for these aircraft is a function of the demand for air transportation. As the global economy becomes ever more connected, and consumers and businesses in developing economies become more affluent, demand for air travel is expected to grow steadily for decades to come. The International Air Transport Association forecasts that the number of boarded passengers worldwide will increase from roughly 3.3 billion in 2014 to 7.3 billion by 2034. That is an average annual increase of 4.1 percent over the 20-year span.

Increasing air travel means stronger demand for civilian aircraft. Moreover, with expectations that air transportation will be increasing in all regions, the demand for commercial jet liners is geographically diverse. The first 787 that rolled out of Boeing's North Charleston final assembly plant was destined for Air India, and the vast majority of that platform's orders are coming from foreign-owned and operated airlines. As of the first quarter of 2015, more than 70 percent of Boeing's 787 backlogs were destined for foreign carriers. More geographic diversity in a company's orders limits its exposure to economic downturns in one region or another.

In addition, producing large civilian aircraft is a very complex undertaking that requires a highly specialized, high-tech set of inputs. Thus, civilian aircraft manufacturing is a subset of a larger and rapidly growing cluster of goods-producing and service-providing industries: aerospace. Components of the broader aerospace manufacturing cluster include, among others, aircraft and parts manufacturing (civil and defense related); search, detection, guidance, and instrument manufacturing; and guided missile and space vehicle manufacturing.

All of these manufacturing pursuits have something in common: powered flight. As a result, the core components of aerial vehicles are made up of precision parts and

specialized materials that are held to a higher standard of quality. This is because the movements are more complex, and the costs of component failure so much higher, for vehicles that leave the ground. Thus, many of the materials, parts, or components used in civilian aircraft can be adapted for use in other aerospace pursuits (military aircraft or unmanned aerial vehicles, for example) and vice versa.

So in terms of economic development recruitment, Boeing South Carolina certainly offers high growth potential in a fast-growing manufacturing cluster. Moreover, given the level of investment the company has made into its facilities in the state, there is virtually no risk that the company will close the facility in at least a generation.

Job Quality

The second key criterion for investing economic development dollars is the number and quality of jobs being created by the targeted cluster. On this score, the aerospace manufacturing cluster ranks high as well.

Employment growth in aerospace product and parts manufacturing was a big boost to South Carolina's manufacturing sector, which was particularly hard hit during the Great Recession. The Bureau of Labor Statistics (BLS) estimates that there were only around 450 workers employed in the state by firms classified in the aerospace product and parts manufacturing industry in 2005. By 2013, that number had increased more than 14-fold, to roughly 6,500 workers. Employment growth in the state began to increase rapidly in 2008 when Boeing started to buy out some of the companies and joint ventures that were supporters of the 787 project in North Charleston and consolidated those operations.

Those new jobs were particularly welcome during the first two years coming out of the trough of the jobs recession. Aerospace product and parts manufacturing was responsible for approximately 23 percent of all net new manufacturing jobs created in the state between 2010 and 2012, despite accounting for only 1.5 percent of the state's total manufacturing job base.

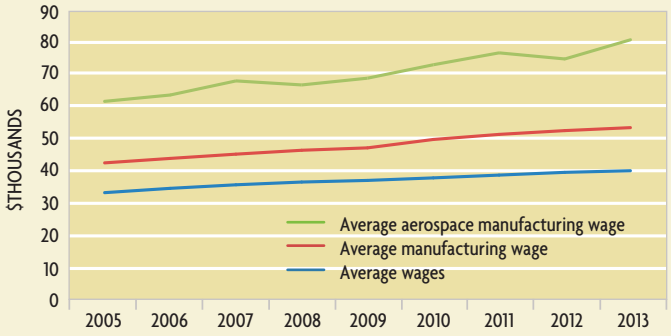
And the jobs created in aerospace manufacturing are well compensated. The average annual wage for workers in South Carolina's aerospace product and parts manufacturing industry was $80,757 in 2013, which is 52 percent higher than the average manufacturing wage in the state and more than twice the state's economy-wide average wage. Moreover, average wages are increasing faster in the industry than in manufacturing or across the state's economy (see chart).

Does South Carolina Have 'The Right Stuff?'

Landing the Boeing plant is more than just a success, however. It represents a tremendous opportunity for South Carolina. While the aerospace product and parts manufacturing industry has seen significant growth in the state between 2005 and 2013 as Boeing's 787 project advanced, there is considerable room to expand further as more firms concentrate in the state. One of the ways in which analysts measure industry concentration in a region is by calculating employment location quotients. Location quotients, or LQs, are a measure of relative concentration that compare an area of interest to a base area (in this case, South Carolina relative to the United States). To calculate an LQ for South Carolina's aerospace product and parts manufacturing industry, one calculates the industry employment share for the state (aerospace employment divided by total employment) and then divides that result by the comparable measure for the nation. An LQ of 1.0 indicates that the industry employment concentration in the state is the same as the national concentration. If the LQ is greater than 1.0, the region is said to have a heavier employment concentration in the industry; if the LQ is less than 1.0, it has a lighter industry employment concentration.

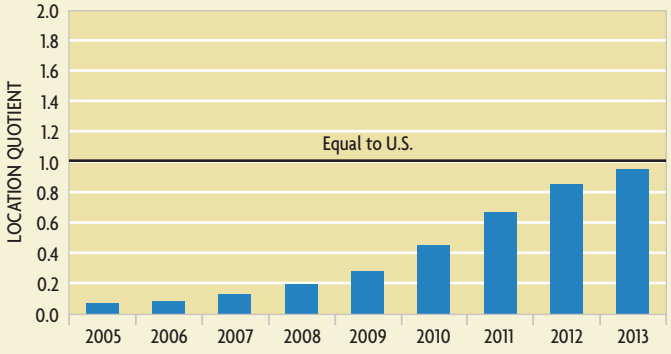
The chart below shows the aerospace product and parts manufacturing employment LQs for South Carolina between 2005 and 2013. There are two striking points to take away from these data. First, the industry concentration is quickly growing in South Carolina. Second, despite that rapid increase, the state's location quotient in 2013 was still just 0.948, indicating that aerospace product and parts manufacturing accounted for a smaller share of total employment in South Carolina than it did in the nation as a whole.

South Carolina Average Annual Wages



SOURCE: Bureau of Labor Statistics Quarterly Census of Employment and Wages

South Carolina Aerospace Manufacturing Density



NOTE: The location quotient is the industry's employment share for the state (industry's employment divided by total employment) divided by the equivalent figure for the nation.
SOURCE: Bureau of Labor Statistics Quarterly Census of Employment and Wages

With 787 production ramping up, and Boeing's footprint expanding in the state, that location quotient will increase.

How much it changes depends on aerospace firms' location decisions in the future. In the near term, regions are not going to be competing for final assembly plants; those decisions are made very infrequently and with long lead times. But South Carolina's existing production facilities will be competing with those in other states for large component projects, especially as new variations on the existing 787 platform are developed.

But the state will also compete for all of the firms that augment the aerospace product and parts manufacturing industry. There are myriad industries, both goods-producing and service-providing, that support the cluster. For example, there are firms that produce the lightweight, high-strength metals and composites that are used in aerospace applications which may choose to locate or expand in the state, as well as those firms that forge, machine, and mold those materials. Similarly, there are a host of services provided to aerospace product and parts manufacturing firms, such as engineering services and staffing services firms, which can help build out the cluster.

There are several factors that determine how competitive a region is in its pursuit of aerospace-related firms, whether goods-producing or service-providing. Two of the most important location considerations are incumbency and labor availability. Incumbency refers to a region's existing aerospace footprint. In that respect, having a final assembly plant in South Carolina provides the state with a sizable competitive advantage over most states as long as the plant is in operation, particularly when it comes to platform-related, large-scale components. Yet South Carolina is not the only state with such an advantage. Washington state, Kansas, Texas, and North Carolina, often mentioned in industry competitiveness assessments as the primary competitors to South Carolina for aircraft product and parts manufacturing firms, also have large and well-established aerospace clusters.

Thus, the determining factors in those decisions may come down to labor factors: cost, labor-management relationships, and skills. South Carolina has some key competitive advantages in this regard — as well as some challenges.

Labor Costs and Relations

Average wage rates in South Carolina are lower than the nationwide averages, including those for the manufacturing industry broadly and the aerospace product and parts manufacturing industry specifically. Moreover, labor-related taxes such as those for unemployment insurance and workers' compensation are competitive.

Beyond labor costs, worker-management relations can have a big influence on an aircraft manufacturer's production location decisions, as the industry has a recent history with disruptive labor strikes. In September 2008, a 57-day work stoppage against Boeing's manufacturing facilities in Everett, Wash., and elsewhere idled approximately 27,000 of the company's workers, according to the Bureau of Labor Statistics (BLS). The stoppage was costly: A 2009 aerospace industry competitiveness study prepared by Deloitte Consulting for the Economic Development Council of Snohomish County, which is home to Boeing's Everett operations, estimated that the 2008 strike cost the company about $6.5 billion in lost revenues and $1.3 billion in lost profits. Moreover, this stoppage was the second against the company in less than five years.

Labor Union Representation

	Union members as percent of workforce	Union-represented workers as percent of workforce
U.S.	11.3	12.4
KS	7.4	9.0
NC	1.9	3.2
SC	2.2	3.2
TX	4.8	6.2
WA	16.8	18.4

SOURCE: Bureau of Labor Statistics, 2014

South Carolina is a "right to work" state with a very low unionization rate and a history of very few work stoppages. In fact, according to the BLS, South Carolina has one of the lowest percentages of union membership in the nation (see table). Regardless of the broader advantages and disadvantages of organizing labor, or of the responsibility for previous work stoppages, the prospect of such events is clearly material to siting decisions. Even though they are not common, the historically high costs associated with work stoppages make a strong argument — from a company's perspective — to minimize those risks whenever possible. This is an area in which South Carolina possesses a clear advantage over some of the other states competing for large aircraft manufacturing operations.

Skills, Skills, Skills

But it is not enough to have a low-cost workforce that presents a low risk of walking off the job. The aircraft manufacturing industry, and aerospace more generally, requires a highly skilled labor force. Each aircraft flying the skies today is built from highly precise parts that took years of R&D, engineering, and systems integration before they were brought to the factory floor. And the aircraft produced today are manufactured with high-tech composite materials, advanced lightweight metal alloys, and precision parts for which there is little room for error. Thus, the jobs that are created to produce aircraft are well compensated because they require specialized skills, especially in science, technology, engineering, and math, the so-called STEM skills. Ensuring a pipeline of workers with those skills will help attract more of Boeing's work, as well as build out the supplier network.

There are a variety of ways to measure a state's workforce readiness. Among the most popular in the aerospace competitiveness analysis are measures of educational attainment. This is an area in which South Carolina can improve if it is

going to make the most of its aerospace cluster. The challenges to the state are evident on virtually all levels of education. In terms of the percentage of the population over the age of 25 with at least a high school education, South Carolina is below the national average as well as lower than three of the four competitor states mentioned above (only Texas has a lower percentage). The comparisons grow less favorable for the state when bachelor's degrees are added into the mix. Here again, South Carolina (at 25.0 percent) trails the national average (29.1 percent) in terms of population 25 years and older with at least a bachelor's degree, and it is lower than all four of the competitor states (see table).

South Carolina not only lags the national average and most of the aerospace competitor states in the broad measures of educational attainment, it also trails in some important measures of STEM-specific readiness and educational attainment. The American Physical Society (APS) compiled a Science and Engineering Readiness Index, or SERI, to measure states' K-12 progress in preparing students for careers in the physical sciences and engineering using standardized eighth grade science and math test scores, as well as a teachers' qualification score and other measures. Once again, South Carolina fell below the national average, and its SERI score was lower than each of the four competitor states.

Thus, it should come as no surprise that the state's averages for STEM-related higher educational attainment measures fall short of the national average. According to the Census Bureau's 2011-2013 American Community Survey, the percentage of total degrees awarded by South Carolina for science and engineering is below the national average and below three of the four competitor states mentioned above.

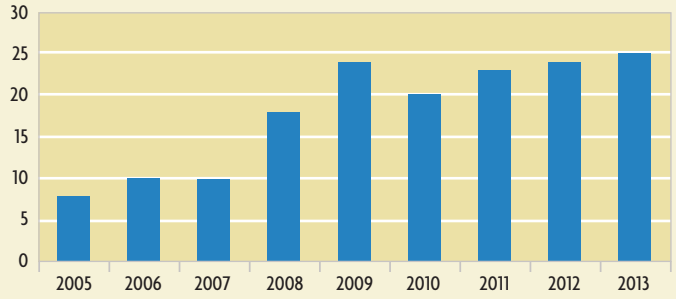
With the preponderance of data showing South Carolina lagging key states (and the national average) in important measures of educational attainment, this appears to be the obvious area where the state can focus its efforts to maximize the impact of Boeing's location decision.

Workforce Preparedness

	Percent of Population 25 and older with:		Percent of bachelors degrees in science and engineering	APS SERI Index*
	HS diploma or greater	Bachelors degree or higher		
U.S.	86.2	29.1	11.8	2.82
KS	90.1	30.5	9.7	3.00
NC	85.2	27.6	10.7	2.34
SC	84.9	25.0	10.0	2.20
TX	81.5	26.9	13.5	2.45
WA	90.2	32.1	14.1	2.86

NOTE: Data for the APS SERI Index are from 2011; all other data are from the 2011-2013 American Community Survey 3-Year Estimate.
SOURCE: Bureau of the Census, American Community Survey; American Physical Society
*American Physical Society Science and Engineering Readiness Index for K-12

Aerospace Manufacturing Establishments in South Carolina



SOURCE: Bureau of Labor Statistics

Conclusion

Boeing's decision to locate its 787 final assembly plant and delivery center in South Carolina has been a boon to the state's economy and has presented it with a unique opportunity. Rarely do regions get the type of kick-start to an industry cluster that South Carolina received. For all practical purposes, the 787 program created an aerospace product and parts manufacturing cluster in South Carolina where none had existed previously.

Still, it is unlikely that the cluster will reach the concentration that it has attained in areas like Seattle because the industry's production process has changed dramatically over the past decade. Whereas once large civilian aircraft were built virtually from the ground up employing a very short supply chain, much of it sourced from within the region, the 787 is assembled from parts and subassemblies that have been produced around the globe, which has diluted the program's potential impact. So South Carolina is competing against regions near and far to bring more of the parts and subassemblies to the area.

By its mere presence, the final assembly plant puts the state in contention for more of the work associated with the program. Indeed, since the decision to locate the final assembly plant in North Charleston, Boeing announced that it would make further investments in the area, adding a new interiors parts manufacturing facility on its campus. But while Boeing continues to increase its investment in the state, and aerospace manufacturing employment has taken off, the number of firms in the industry has grown only slowly. The number of establishments in aerospace product and part manufacturing increased threefold between 2005 and 2009, but it has been flat since, suggesting that virtually all of the jobs in the cluster are being created by very few firms (see chart).

Diversifying the aerospace manufacturing cluster's employment base, building out the supply chain, and enticing ancillary firms to locate or expand in the area will require a highly skilled workforce. South Carolina would do well to build on its current competitive advantages by focusing more attention on closing the skills gaps with its primary competitor states. **EF**